RESTORATIVE ENVIRONMENTS' INFLUENCE ON COGNITIVE FLEXIBILITY IN DEVELOPING ADULTS

by

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A thesis submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Master of Science

Parks, Recreation, and Tourism

The University of Utah

May 2011

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The University of Utah Graduate School

STATEMENT OF THESIS APPROVAL

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ABSTRACT

Natural environments have been shown to have many psychological benefits for the human psyche. Among these benefits are mental stress reduction, positive emotional impacts, and attention restoration. Cognitive Flexibility is the ability to alternate perspectives due to changing situational demands. This ability is helpful in stopping habitual thought processes and behaviors. The purpose of this study was to explore restorative environments' impact on one's ability to be cognitively flexible. Sixty-three undergraduates at the University of Utah completed a pre- and postassessment of the Attention Network Test and viewed a 13-minute film of either urban or natural type environments between assessment points. Factorial ANOVA was utilized to explore between-group differences. Results show individuals in the urban condition had significantly faster response times when assessing congruent trials (where flexibility is not needed) than those in the natural condition. Though there was no evidence that natural environments quickened flexible responses, there is some indication that urban environments may perpetuate habitual ones.

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CHAPTER I

INTRODUCTION

Research in health-related fields is growing rapidly and is becoming increasingly interdisciplinary. Such research has resulted in numerous recommendations that individuals take preventative interventions such as exercise, healthy eating habits, and healthful lifestyle behaviors rather than waiting for prolonged exacerbations of symptoms. A powerful but underutilized preventative intervention is spending time in and interacting with natural environments. Attention to this intervention is growing as fields such as ecotherapy, horticulture therapy, and wilderness therapy continue to publish research as to the effectiveness of using elements of the natural environment to facilitate healthful outcomes (Gross & Lane, 2007; Jacob, Jovic, & Brinkerhoff, 2009; Pedretti-Burls, 2007)

Research has shown that exposure to natural environments promotes stress reduction, attention restoration, faster recovery from surgery, greater physical health, and positive mood, but the process by which they do this needs further explanation (Berman, Jonides & Kaplan, 2008; S. Kaplan, 1995; Ottosson & Grahn, 2008; Staats, Kieviet, & Hartig, 2003; Ulrich, 1979; Ulrich et al., 1991). Though these benefits have been documented and a preference for outdoor elements has been noted, natural environments are often underutilized in clinical settings

(Whitehouse, 1999). More relevant research is needed concerning how natural environments work in facilitating select therapeutic outcomes. Health professionals are just beginning to become equipped with evidence that allows them to "prescribe" a client with a particular disorder/disability to take some time outside. However, many professionals are unaware, or discount current evidence.

Recreational therapy professionals use recreational interventions to help individuals with disabilities to reduce limitations and increase health and functioning. This includes neurological and psychological limitations. Recreational therapists currently use indoor clinical settings, activity rooms, community centers, and outdoor venues to provide their services. As research concerning environment continues to unfold and demonstrate its relevance, recreational therapists will become increasingly needed to facilitate nature-based interventions with varying populations in need of its many benefits.

Many psychopathologies are associated with an inability to think flexibly (Davis & Nolen-Hoeksema, 2000; Godshalk, 2004; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Individuals diagnosed specifically with anxiety disorders, clinical depression, eating disorders, and personality disorders (borderline specifically), as well as those struggling with substance abuse and addiction have a difficult time being aware and letting go of unhelpful thoughts. They continually get caught in fixed cognitive processes, and many struggle with seeing a different point of view. Individuals with physical impairments (TBI, Spinal Cord Injury, and Amputation) and those with neurological disorders are likely to experience clinical depression at some point during or after recovery. This being the case, the ability to think flexibly in order to cope with change is

important throughout the large spectrum of disability. Other affected populations may include those with Autism, Asbergers Syndrome, and other social disorders. Individuals in these populations may struggle with perseveration (fixation with recurring responses). While ruminating, obsessive thoughts are more common in those with mental disorders, developmental research shows differences in flexibility in adult populations without diagnoses (Merriam, 2008; Moshman, 1998; Perry, 1970; Sinnott, 2008; Wu & Chiou, 2008).

In the Leisure Well-being model (LWM) for Recreational Therapy, Carruthers and Hood (2007) emphasize utilizing a variety of leisure strategies to facilitate well-being. Among these is Mindful Leisure. They propose that leisure and activity participation bring about positive emotion in the moment which will help individuals "find a non-habitual way of looking at the world, focusing attention on the immediate moment and experience…[creating] an open awareness that is in contrast to habitual ways of processing the world" (p. 286). Based on this assertion, building cognitive and psychological resources such as mindfulness and flexible thought patterns are current goals of recreational therapists.

Cognitive flexibility has been defined as "the ability to restructure knowledge in multiple ways depending on the changing situational demands" (Chikatla & Reese (n.d.); Jacobson & Spiro, 1995, para. 1). The practice of taking alternate perspectives by learning and exposure develops cognitive flexibility (Epley, Morewedge, & Keysar, 2004). Cognitive flexibility helps individuals have effective social interaction and promotes the ability to adapt to changing circumstances (Biglan, 2009; Canas, Quesada, Antoli, & Fajardo, 2003; Godshalk, 2004). Cognitive flexibility on a micro scale is an

executive functioning process determining how quickly one can switch mental sets. For example, after being told different rules for specific circumstances in a neuropsychological task, cognitive flexibility has been measured by the speed and accuracy of the individual in switching to a different rule dependent on the circumstance. On a macro scale, cognitive flexibility is used when solving complex problems, ethical issues, or taking a different perspective. The plasticity of the biological brain makes cognitive flexibility possible, but also difficult depending on what assertions individuals are exposed to and what beliefs about the world are continually strengthened (Garraghty, Churchill, & Banks, 1998).

Cognitive science tells us that neural pathways leading to a specific line of thought or belief are strengthened every time the belief is confirmed (Hebb, 1949). Hence, simple thoughts like- "the canary is yellow," if always confirmed will result in a strong neural connection in the brain (linking yellow and canary). Likewise, psychologically unhelpful beliefs such as "people who do not say hi must hate me" can also become an automatic physiological neuronal response (in the form of thought). Studies have shown that these pathways strengthen over time and if beliefs are left unquestioned people will become more rigid in their thought patterns (Jacobsen & Spiro, 1995). Breaking habitual thought patterns often requires new emotional and cognitive experiences. A wide range of experiences and environments help to change cognitive redundancy. Unthreatening natural environments may provide possibilities for such change to take place.

For urban dwellers, natural environments have been found to facilitate thoughts different from those that typically occur in one's day-to-day life. Evidence has shown that

viewing scenery and/or wildlife and spending time in wilderness has the ability to not only create positive mood, but also elicit distinctive themes of thought. People tend to become reflective, contemplative, and appreciative of the beauty around them in natural environments (Farber & Hall, 2007; Kaplan & Talbot, 1983). These cognitive changes may be attributed to components of what has been termed restorative environments. Restorative environments have four common characteristics: Being Away—settings that offer individuals a chance to disconnect physically, and cognitively from normal routines and concerns; Fascination—holds attention without effort; Coherence/Extent—having enough to look at fluidly; and Compatibility—supporting the goals and inclinations of the individual (R. Kaplan, 2001).

When individuals experience atypical thoughts, they have more physiological ability to create new neural pathways, switch mental sets (be cognitively flexible), and take new perspectives (Garraghty et al., 1998). When individuals act outside of their normal routines and settings (Being Away), they may be more likely to reconsider their current beliefs and life choices. Fascination, another characteristic of restorative environments, is the component most strongly associated with the capacity to recover from attention fatigue. This is due to involuntary attention being engaged rather than directed attention, which causes mental fatigue (James, 1892; S. Kaplan, 1987). Cognitive flexibility and executive attention use similar cognitive faculties suggesting that cognitive flexibility may be influenced by restorative environments in the same manner as attention.

Additionally, fascination has been related to mindfulness meditation in that it draws attention but is not exhaustive (R. Kaplan, 2001). Mindfulness meditation (MM)

practices have been directly associated with high levels of cognitive flexibility (Moore & Malinowski, 2009). Given that fascination performs a similar function to mindfulness it is reasonable to speculate that being fascinated in a natural environment may help facilitate the ability to think flexibly.

These and the other characteristics of restorative environments have been shown to restore fatigued executive functioning (Berman et al., 2008; S. Kaplan, 1995; R. Kaplan, 2001; Tennessen & Cimprich, 1996). However, these studies have focused specifically on attention as a whole, neglecting cognitive flexibility, which is also considered a common process of executive cognitive functioning. Recreational therapists may become increasingly needed to facilitate activities in restorative environments if these processes are found to be effective in perpetuating the therapeutic benefit of flexible thought. The purpose of the following research is to offer evidence pertaining to the importance of a recreational therapist's venue choice for achieving therapeutic outcomes, as well as provide further evidence as to how restorative environments influence brain function.

Although it is reasonable to suppose that exposure to natural environments enhances cognitive flexibility, there are reasons that such exposure may not. The ability to be cognitively flexible is a complex cognitive process perhaps affected more by processing speed, inhibition, and other executive functions that operate independent of environment. Socialization, habituation, health status, and/or genetics may play a stronger role in determining cognitive flexibility capacity than environment. The stress chemical, cortisol, has been found to damage nerve cells, specifically those involved in memory and learning (Sinnott, 1999). The physiological stress relief found in natural

environments may be indicative of the cognitive changes discussed rather than the neural reformation of pathways caused by thought.

Given these speculations, as well as the proposed relationships discussed previously, the purpose of this study is to see if exposure to a restorative environment influences the ability of a young adult population to think flexibly.

CHAPTER II

LITERATURE REVIEW

Cognitive Flexibility

Cognitive flexibility has been studied under a variety of names, in numerous fields. Similar concepts include fluid intelligence and psychological flexibility. Each of these concepts differs slightly. However, throughout these studies, cognitive flexibility can be understood *as how rapidly an individual is able to switch cognitive set and conceptualize an alternative perspective* (Canas, 2003; Cools, Ivry, & D'Esposito, 2006; Jacobson & Spiro, 1995; Schaie, 1991). This may be adjusting to changing color or shape rules in a neuropsychological task such as the popular Stroop task or Wisconsin Card Sort, or it may be changing approaches after unsuccessful attempts with certain behaviors or communication strategies.

Achieving a high level of cognitive flexibility is not guaranteed and not necessarily the "normal" or typical developmental course. However, certain variables do influence whether cognitions and behaviors become flexible or rigid. Though adaptive levels of flexibility are not experienced by all, cognitive flexibility has been shown to have numerous psychological benefits. Among these is the ability to experience successful transitions during changing life events, increased caring for others, increased

forgiveness (Biglan, 2009), increased adaptability to changes in the environment (Canas, 2003), and increased ability to shift attitudes (Godshalk, 2004).

Researchers have explained flexibility from a developmental perspective, presenting it as an achievable postformal operational cognitive skill; as well as from a neuropsychological perspective, showing biological differences in the prefrontal cortex in various populations.

Neuronal cognitive development slows substantially at young adulthood (Gross, 2000). This slowing not only happens on a biological level, but observable change in behaviors and reasoning skills are less pronounced. This slowing has led fewer cognitive researchers to explain cognitive changes *throughout* the lifespan. Due to less developmental change after adolescence, research in adult cognitive development has been delayed. In recent years, however, there has been an increase in literature observing both biological changes and noticeable qualitative differences in adults. Neuroscience continues to support the ongoing plasticity of the human brain (Garraghty et al., 1998). Synaptogenesis continues in the adult brain, specifically in the region of the hippocampus (Gross, 2000). Neuroimaging techniques show that the structure of the brain changes during the learning process (Merriam, 2008). This evidence provides some quantification for cognitive changes in the adult brain that had been seen previously by marked differences in reasoning styles and abilities.

Piaget's seminal work on cognitive development culminates with what is termed Formal Operational thinking. Formal Operational thinking is characterized by the ability to think abstractly, problem solve, and use deductive reasoning. This type of thinking is often regarded as the final stage in cognitive development. Researchers have expanded on

Piaget's work, creating a broad line of work specifically addressing Post-Formal Operational thought (Basseches, 2005; Kahlbaugh & Kramer, 1995; Kramer, Kahlbaugh, & Goldston, 1992; Merriam, 2008; Moshman, 1998; Perry, 1970; Sinnott, 2008; Wu & Chiou, 2008). Numerous themes have emerged from research on Post-Formal Operational thought. Among these themes, one of the most apparent is cognitive flexibility (Sinnott, 2008).

Sinnott (2008) suggests that as adults continue to learn and live, they are exposed to numerous perspectives of truth and ways of living, thereby creating a flexible way to view the world and create personal meaning. This claim is supported by research that has examined learning environments offering a variety of perspectives and learning strategies and has shown that such environments perpetuate better recall and more flexible thought (Canas, 2003; Jacobsen & Spiro, 1995). Godshalk (2004) showed that individuals taking the perspective of those who synthesize a variety of opinions versus those who make judgments display more cognitive flexibility in personal attitudes toward sexual harassment. Biglan (2009) presented evidence that when individuals are trained to accept but "hold lightly" to strong emotionally charged opinions, they have greater ability to be flexible in their judgments of themselves and others. These studies give evidence that cognitive flexibility can be developed by interventions that assist the individual in switching perspectives.

The human capacity to take perspective is quite complex and dependent on development. The ability of a child to understand that another individual has a separate mind from him/herself and therefore a different perspective emerges around age four (Wimmer & Perner, 1983). This ability is called Theory of Mind. As individuals continue

to develop, they slowly become less egocentric and they are able to more quickly understand perspective and correct egocentric responses (Epley et al., 2004). The ability to take another's perspective has been described as not only time-dependent (increases as we grow older), but also practice-dependent (Epley et al., 2004). By giving individuals a chance to reconsider their own perspectives, cognitive flexibility is promoted.

As attractive as a natural developmental process for cognitive flexibility seems, it is not the course for all adults. Some individuals may not receive exposure to a variety of perspectives, thus having their own beliefs strengthened to an extent of inflexibility. In addition, some may become exposed to many perspectives prior to developing any ability to cope with numerous changing circumstances, thus resulting in a state of confusion and anxiety. Others, such as those with autism, have inborn biological differences that make cognitive flexibility challenging.

Rigidity

The opposite of flexibility is inflexibility or rigidity. Perseveration and rumination are two forms of psychological rigidity. Perseveration is the repetition of the same response style, even when that response may be maladaptive. Perseveration is often due to overfocused attention (Liss, Saulnier, Fein, & Kinsbourne, 2006). Recurring thought processes that are united by a common theme is called Rumination. Rumination is often used synonymously with brooding, or worrying (Whitmer & Banick, 2007). Those who perseverate, and ruminate more frequently are more likely to experience unsuccessful social relationships, increased anxiety, depression, and other pathologies (Davis & Nolen-Hoeksema, 2000).

Adults demonstrate varying levels of cognitive flexibility. Older adults who are not exposed to an engaging lifestyle environment have been shown to be less cognitively flexible (Stine, Parisi, Morrow, & Park, 2008). Additionally, those with high levels of depression and anxiety tend to ruminate longer on redundant negative cognitive sets (Davis & Nolen-Hoeksema, 2000). Rumination has also been associated with other pathologies such as bingeing and self-harm (Nolen-Hoeksema et al., 2008).

Inhibition and rumination have been found to be important factors in perseveration. Whitmer and Banich (2007) found that inhibition abilities are vital as a defense from recurring depressive thoughts, whereas those who struggle with rumination find it difficult to become flexible once they experience intellectual or angry perseveration. This demonstrates that rigidity has the potential to be an issue for people with and without mental diagnoses. Strong emotion paired with ruminating thought patterns provide ideal circumstances for inflexibility in all populations.

There are numerous suggested causes for psychological rigidity. These include stress/anxiety, reinforced belief systems, socialization, personality, and genetic differences. Davis and Nolen-Hoeksama's (2000) research suggests that distractions using external environments help to decrease self-focused rumination. Distractions in this case were enjoyable activities. Taking this into account, it is reasonable to assume that environments that require attention to be specific and fixated, or cue ruminative tendencies will facilitate psychological rigidity. Conversely, environments that allow for involuntary attention, and perpetuate nonhabitual lines of thought allow for cognitive flexibility.

Attention and Flexibility

Attention has been distinguished as having three main networks: alerting, orienting, and executive attention (Posner & Rothbart, 2007). Alerting is the ability to be sensitive to incoming stimuli, orienting is the ability to decide what to alert to, and executive attention "involves mechanisms for monitoring and resolving conflict among thoughts, feelings, and responses" (p. 7). Given this definition, cognitive flexibility can be thought of as a related subcomponent of executive attention. Flexibility and executive attention have often been studied using the same neuropsychological tasks (Cimprich & Ronis, 2003; Hartig, Evans, Jamner, Davis, & Garling, 2003) and similar areas of the brain are associated with executive attention performance and cognitive flexibility performance including the prefrontal cortex, the left lateral regions of the brain, and the basal ganglia (Cools et al., 2006; Posner & Rothbart, 2007).

Mindfulness Meditation (MM) uses observational attention practices to focus on the present (Brown, Ryan, & Creswell, 2007). Recently, Mindfulness Meditation has been directly related to increased levels of cognitive flexibility (Moore & Malinowski, 2009). Mindfulness Meditation has also been shown to decrease ruminative thinking in individuals with mood disorders (Ramel, Goldin, Carmona, & McQuaid, 2004).

In Stine, Parisi, Morrow, and Park's (2008) analysis of cognitive flexibility in older adults, they performed a randomized trial. One of the prescriptions for the experimental group was participation in creative activities. The purpose of these activities was to be enjoyable and absorbing, having an element of mindfulness. Those that participated in these activities exhibited greater levels of flexibility. This example

displays the impact of an experience facilitating mindfulness on the development of cognitive flexibility.

Shiffrin and Schneider (1977) explained that cognitive processes are either controlled or automatic. Much of the time, our thinking is automatic and repetitive, making it hard to realize when our self-talk cognitions are unhelpful. Adults search for meaningful experiences in order to continually adapt their view of the world (Sinnott, 2008). Experiences that are different from day-to-day routines bring our attention to thoughts that are new and different from reinforced neural pathways, causing an increase in cognitive flexibility (Garraghty et al., 1998; Hebb, 1949).

Measurement of Cognitive Flexibility

Cognitive flexibility has been assessed on both a micro and macro scale. Neuroimaging studies have found that among others areas, the lateral prefrontal cortex (PFC) is the most critical area of the brain for cognitive flexibility (Cools et al., 2006; Fan, McCandliss, Sommer, Raz, & Posner, 2002). Because executive functioning is most commonly associated with the PFC, microcognitive flexibility assessments target a variety of higher cognitive abilities. These assessments often have subcomponents such as task switching to assess the ability to switch cognitive set depending on changing circumstances or rules. The Delis-Kaplan Executive Function System (DKEFS) is an example of one of these tests.

Researchers have used tasks of conflict to measure executive attention. The Stroop Color-Word task has been used to measure cognitive flexibility and executive attention specifically because of its focus on rule switching (Fan et al., 2002). A wide

variety of executive functioning and selective attention assessment techniques typically match a stimulus with an abstract rule, and then alternate stimuli (Cools et al., 2006; Moore & Malinowski, 2009; Schaie, 1991). The Attention Network Test (ANT) is an example of one these stimuli-rule techniques requiring individuals to assess congruent and incongruent stimuli and respond accordingly. Three differing elements of the test measure alerting, and orienting abilities, as well as executive attention. The ANT is often preferable because of its sensitivity to independent functioning of brain areas, and its sensitivity to differences between individuals (Fan et al., 2002).

Other authors have used a scenario or macro scale approach in cognitive flexibility assessment. Canas (2003) described an experiment in which participants were given a problem-solving task scenario simulating firefighters responding to an emergency situation. With group 1, the scenario did not change over multiple trials, and in group 2, the scenario changed each time. Presented with a final task, individuals from the changing scenario group (2) more readily switched strategies, while those from the unchanging scenario group (1) continued to repeat the same strategy. While the first group may have become expert at one scenario, the second was able to more easily adapt to changing circumstances showing greater amounts of cognitive flexibility.

The micro scale and macro scale description of cognitive flexibility may seem largely divergent. However, there is sufficient evidence to suggest that cognitive activity is similar when being flexible with response rules as well as attitudes, strategy, and opinions. Ochsner et al. (2004) showed that interpreting another individual's emotional state activated the left lateral prefrontal cortex (Broca's speech/language area) suggesting that higher cognitive functioning (cognitive flexibility) is used to accurately assess

another's perspective. Lending support to this idea is research linking language abilities to cognitive flexibility. Deak (2003) gives an extensive argument for the flexibility needed for children to learn language, as well as language influencing our ability to be flexible. He states, "Though laboratory tests of flexible cognition (e.g., task-switching) typically ignore the role of symbolic knowledge, virtually all of these tasks use instructions to orient participants to the task, and abstract symbols to cue task switches. Perhaps, then, basic symbol mapping knowledge is needed for cognitive flexibility" (Deacon, 1997 as cited in Deak, 2003, p. 318). While the relationship between language and flexibility is complex, it helps in understanding how the micro form of symbols relates to the macro form of perspective change. Language and cognition are inextricably linked (Hoff, 2001) and both are influenced by experience and exposure. As we apply representation and symbols to our understanding of the world, we form biological associations (Hebb, 1949). *Being away* from a typical environment strengthens thought patterns that are used less frequently.

Natural Environments

Natural environments and depictions of natural environments have been shown to have numerous psychological and physiological effects on humans. Researchers have described a range of ways the environment influences psychological states. Knez (1995) found lighting affected mood, problem solving, recall, and recognition with men performing better in cool lighting versus women in warm lighting. College students have been shown to have a preference for running outdoors, during which their mood state is more positive, and they have more positive perceptions of the environment (Hooper &

Ives, 2002). This study's use of a control group supports the idea that the environment acts as an independent predictor of elevated mood aside from physical activity. Additionally, other studies have found that outdoor recreation is associated with affect regulation, but these results may be due to either the outdoor environment, participation in recreation, or a combination of both variables (Tarrant, 1996). Similarly, research looking at participation in horticulture, conservation activities, and other ecotherapy approaches (Gross & Lane, 2007; Jacob et al., 2009; Pedretti-Burls, 2007) have found numerous benefits including well-being, escapism/flow, ability to reassess views of self, feelings of connection with nature, greater ability to problem solve and build skills, and less negative judgments of self. However, these studies incorporate variables of activity and environment, making it difficult to parse out whether the impact is due to the environment, the activity, or an interaction effect.

Two well verified and notable benefits of exposure to natural environments are attention restoration (ART) (Berman et al., 2008; Berto, 2005; S. Kaplan, 1995; R. Kaplan, 2001; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2008; Tennessen & Cimprich, 1995) and stress reduction (Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998; Ulrich, 1979, 1991; Whitehouse, 1999). These two benefits are possible because of the thought patterns facilitated by being away, as well as the cognitive relief that fascinating environments offer.

Fascination, Attention, and Cognitive Flexibility

The Kaplans outline two areas of attention involved in understanding the environment, directed attention and fascination. Directed attention is an active process

used while going about routines and solving problems. Fascination (involuntary attention) is defined as being effortless, without racing, problem-solving thoughts, and theoretically, is responsible for the restorative quality of natural environments. As cited in experimental studies, fascination is one mechanism that provides the ability to sustain directed attention later on (Berto, 2005). This mechanism has been measured by the differences in eye movements when observing restorative versus nonrestorative environments. Although look time is similar, less intense fixation to the interactions within a scene are observed while participants are viewing restorative scenes (Berto, Massaccesi, & Pasini, 2008). This suggests that directed attention is not being fatigued in natural environments, yet these environments are still captivating to the onlooker.

Fascination requires alerting, orienting, and executive attention networks to stay active, but not to be exerted to the extent of fatigue. Look time is indicative of alerting and orienting, but is not telling of executive attention processes. The influence of fascination on executive attention may be seen by the slowing of thoughts, lowering of anxiety and stress levels, or by a test requiring flexibility with conflict. Berman et al. (2008) hypothesized that executive attention abilities would be restored above the abilities to alert and orient due to executive attention's high cognitive engagement. Using the Attention Network Test, individuals scored higher on the executive attention measure after viewing pictures of nature scenes versus urban scenes. Restorative Environments have also been shown to increase inhibition and concentration abilities, leading to decreased dementia in elderly and increased self-discipline in young girls (Blackman, Van Schaik, & Martyr, 2007; Ottosson & Grahn, 2005; Taylor, Kuo, & Sullivan, 2002).

Stephen Kaplan draws the similarity between fascination evoked by restorative environments, and Mindfulness Meditation. He postulates that although meditation is a direct process the participant actively engages in and fascination is without active engagement, both have the similar end result of "fostering cognitive activity whose content contrasts with the content that typically occupies the mind" (R. Kaplan, 2001). In an analysis of mindfulness research, Brown et al. (2007) allude to the same differences stating,

> The primary difference between mindful and reflexive attention concerns the quality or nature of attention deployed. Consciousness is thought to serve two basic capacities: monitoring and control, where the former [mindful/fascination] is an "observer" function, while the latter [directed attention] is a goal-directed agent of maintenance and change. (p. 216)

R. Kaplan (2001) shows how Being Away and Fascination fulfill two mandates of Mindfulness Meditation. The first mandate of MM is to "avoid calling on tired cognitive patterns by changing tasks reasonably often…" (p. 3). Kaplan parallels this with Being Away. This first mandate gives explanation as to why practitioners of Mindfulness Meditation perform well on measures of cognitive flexibility (Moore & Malinowski, 2007). The second mandate is "Avoid unnecessary effort by learning to recognize, seek, and create supportive environments." (p. 6). Kaplan suggests that our inherent fascination with natural environments is due to evolution and the need to be subtly aware of immediate surroundings, instead of directing attention at one stimulus. Often when in natural environments people state a sense of familiarity (Kaplan & Talbot, 1983). By recognizing the therapeutically supportive benefit fascinating environments give, executive functions such as cognitive flexibility and directed attention can be restored.

Thoughts, Stress, and Cognitive Flexibility

Another well-known benefit of natural environments is that of stress reduction. Ulrich (1979, 1991) performed a classic study where he exposed a group of patients in a hospital setting to natural environments via a window, while others had no window, or a window with an urban setting. Patients with the natural stimulus complained less to staff, had quicker recovery times, elevated affect, and lower indications of stress, including lower cortisol levels. Although Ulrich did not address the cognitive impacts directly, variables such as mood, stress, and amount of complaining are dependent on the mental state of the individual.

Evidence has shown that viewing scenery and/or wildlife has the ability to not only create a positive mood, but also perpetuate common themes of mental thought. During the formation of the original idea of restorative environments, Kaplan and Talbot (1983) evaluated writings of participants of a 2-week wilderness experience. They assessed their personal journals gleaning the cognitive impact this experience had on the individuals. Applicable themes from the journals included noting the enjoyment of a slow pace, time to think, learning about thoughts and emotions through self-insight, and increased happiness and self-confidence. In a similar fashion, Farber and Hall (2007) did a qualitative study finding that visitors in Alaska had a more positive affect after viewing these natural scenes. More importantly, their overall experience facilitated cognition about themselves and their environment. Many of the narratives collected from the participants in this study included reflective cognitions not associated purely with emotion. These included noting lessons they learned, thoughts about care for the environment, and nostalgia or imagination. Taken together, these studies suggest that

natural environments evoke a state of mind where thoughts are slowed (not attending to life stressors), are more reflective and positive, and are atypical from thoughts that inhabit our minds in urban environments. These atypical thoughts can create new neuronal associations, giving the individual a larger repertoire of possible cognitive paths. In the future, when the individual encounters changing situational demands, a more flexible cognitive style can be realized (Garraghty et al., 1998; Hebb, 1949; Jacobson & Spiro, 1995).

Both the Kaplans and Robert Ulrich argue that humans' attraction to, and wellness in, outdoor environments has been a result of evolutionary adaption (S. Kaplan, 1987). Ulrich and others have postulated that the areas of the nervous system associated with interpreting natural environments developed early on in human evolution (Joye, 2007). Complementary to Edward Wilson's Biophilia Hypothesis, both theorists assume an inborn mechanism. The Kaplans, however, acknowledge the cognitive impact restorative environments may have on mental processes, whereas Ulrich believes that stress reduction caused by natural environments is solely an automatic built in response (Kahn, 1997; R. Kaplan, 2001). However, the regulation of stress is dependent on the *thoughts* one has when stressful events occur. If an individual sees what looks like a snake, the body responds with the physiological flight-or-fight rush of adrenaline (a built in response) because the individual concluded cognitively there was a snake, whether the cue was actually a snake or a curled stick. Therefore, it is most likely the thoughts perpetuated by natural environments help to regulate mood and elicit positive affect. However, it is still uncertain if the mechanism guiding cognition is inborn, or dependent upon experience.

In one of their original works, *Cognition and Environment*, the Kaplans' (1982) propose that restorative environments offer clarity rather than cognitive chaos. Somewhat crudely, they describe a state of mind not unlike an individual with anxiety, depression, or some other form of mental illness- "People who are well fed, well clothed, and well supplied with physical comforts but who are confused about 'who they are and where they are going and what it all means' have been known to suffer so severely that they jump out of windows" (p. 113). The Kaplans go on to explain how the factors that determine preference of environment are the same factors that support cognitive clarity for the individual. These factors include fascination and being away. In this same text the Kaplans discuss the ability to cope with changing circumstances; although not stated as such by these authors, coping with changing circumstances is the central idea behind cognitive flexibility. They emphasize the need to be able to interpret the environment in order to comprehend and feel in control. Fascinating environments do not overload the individual and executive functioning; hence, adequate coping (or cognitive flexibility) can be achieved. In addition, being away from environments that continually strengthen habitual thoughts creates a space to develop unique cognitive patterns.

Restorative Environments' Study Design

Research assessing the impact of environment on cognitive or psychological states has used numerous strategies in demonstrating relation. Among these are comparisons of hospital patients with windows and those without (Ulrich, 1991), surveying reactions to photographs or films of restorative environments (Berto, 2005; Kaplan, 1987), interviewing individuals after a trip in a wild environment (Farber & Hall,

2007) and assigning individuals to a walk in either a natural or urban environment (Berman et al., 2008). While real time exposure to environments lacks a good deal of experimental control, the amount of dosage to environment in a lab setting becomes an issue. For example, differences may be expected in the amount of restorative influence photographs, films, a walk, or a 7-day trip in a natural environment has. Mayer et al. (2009) showed that this is the case; individuals exposed to a virtual version of a walk did not have changes in mood whereas those exposed to an actual walk had an increase in positive emotions. Those individuals in a third condition were shown a virtual urban experience and increased in negative affect. In this same study, researchers found that virtual urban environment exposure led to a decrease in the ability to self-reflect; however, individuals in the virtual or real natural environment exposure reflected similarly. Kort (2006) showed that films with a greater amount of immersion to the restorative experience have physiological influence in the reduction of stress symptoms, but participants did not report significant differences in their own mood, and sense of presence. While these differences cannot be ignored, still photographs, window views, and films have effectively found differences in attention restoration comparing natural and urban exposure (Berman et al., 2008; Berto, 2005; Hartig et al., 2003; R. Kaplan, 2001; Tennessen & Cimprich, 1995).

Though a considerable amount of research has been done in the area of attention restoration, cognitive flexibility, a related executive functioning mechanism, has been largely ignored in the restorative environment literature. Numerous fields have noted the therapeutic benefits of restorative environments but the process by which it offers these benefits is not understood. Cognitive flexibility helps individuals adapt to changing

circumstances and avoid mental pathology related to rigidity. The purpose of this research is to offer evidence that restorative environments cultivate cognitive flexibility. This has implications for the general population, as well as health care practitioners, specifically professionals that plan for the client's recreational needs.

Hypothesis 1: Individuals viewing a film of natural environments will find the environment as potentially more restorative as measured by the Perceived Restorativeness Scale than individuals who view a film with urban environments.

Hypothesis 2: An interaction will occur between Condition (Nature/Urban), Time (Pre/Posttests), and Warning Type (Incongruent/Congruent trials). Differences in mean reaction times will be significant between the Posttest, Nature Condition, Incongruent trials cell, and the Posttest, Urban, Incongruent trials cell.

CHAPTER III

METHODS

Participants

This study used convenience sampling to recruit 75 participants from the Psychology Department's subject pool at the University of Utah. Participants were given research credit hours in compensation for their participation. Upon arrival at a small computer laboratory, all participants completed an informed consent form as directed by the University of Utah institutional review board. The sample consisted of 26 females, and 37 males. Ages ranged from 17-53 years of age with a median age of 21 and average age of 23 +/- 6.3; 83% of the participants were single. Nonstudents were excluded from participation. About half of the sample (52%) had attained sophomore standing or higher. Twelve participants were removed from the analysis because of deviations from the study's protocol. Among these deviations were computer technical errors, sleeping during the study, and/or extended personal time taken during the experiment. The final sample size was $n = 63$. From these 63 participants, 33 viewed the film of natural environments (Condition B); 30 participants were assigned to the urban environment condition (A).

Measures

An adapted version of the Perceived Restorative Environments Scale (PRS) was used to assess participants' experience of a video as being restorative (Appendix A). The scale assesses subcomponents: being away, fascination, extent, and compatibility. The adapted PRS is an 8-point Likert scale instrument where participants are asked to agree/disagree with six questions, three for each dimension. Example questions include "I would like to spend more time looking at the surroundings here (Fascination)" and "Being in this place would be an escape experience for me (Being Away)." A 7 on the scale represents very much so, and on the low end a 0 indicates not at all. In addition, two general restorative questions were asked: "Being in this place would make me feel restored," and "This place would help me feel restored." The scale performed reliably in this study and exhibited a Cronbach's alpha score of 0.96. Item-to-total correlations ranged from 0.421 to 0.920. As a group, Extent items exhibited the lowest item-to-total correlations (Table 1).

The Attention Network Test was used to assess cognitive flexiblity. The Attention Network Test assesses the ability to alert, orient, and use executive attention. Cognitive flexibility was assessed by response time on the executive attention component of the test; however, the participants completed measurements in all areas of attention as the trials are not mutually exclusive in assessing, alerting, orienting, or executive attention separately. In order to assess the executive network, participants responded to arrow stimuli by pressing keys on a keyboard indicating right or left. The central arrow was either surrounded by arrows congruent or incongruent to its direction. Switching rules and incongruent patterns worsen performance, but individuals with higher levels of

Table 1

Reliability Scores for Current Sample on Adapted Perceived Restorativeness Scale

Dimension Item	Item to Total Correlation	Cronbach's Alpha if Item Deleted
Fascination 1 (Q1)	.822	.958
Fascination 2 (Q2)	.724	.960
Facination 3 (Q3)	.910	.956
Being Away 1 (Q4)	.889	.956
Being Away 2 (Q5)	.868	.957
Being Away 3 (Q6)	.880	.956
Extent 1 (Q7)	.427	.965
Extent 2 (Q8)	.421	.966
Extent 3 (Q9)	.577	.963
Compatability 1 (Q10)	.825	.958
Compatability 2 (Q11)	.881	.956
Compatability 3 (Q12)	.839	.957
Restorative 1 (Q13)	.915	.955
Restorative 2 (Q14)	.920	.955
Q=Question #		

executive functioning and flexibility exemplify quicker response times, specifically on incongruent versus congruent stimuli.

A three-question English Task Fluency Questionnaire was used as a measure of control. The questionnaire assesses participants' level of familiarity with the English language. Previous experience with the Attention Network Task was also assessed.

Materials

A 13.8 minute film of urban environments was utilized for Condition A. The film was made by gathering permission from various Youtube authors (Appendix B). Films were either high quality or high definition versions. The urban film included films of aesthetic man-made water fountains, and films of downtown Ann Arbor Michigan focusing both on overall urban areas including streets, cars, and buildings, as well as store fronts including sidewalks, signs, and people. Rewritten audio was used to faciliate common fountain and urban sounds.

A 13.5 minute film of natural environments was the stimulus for Condition B. Three Youtube film authors were contacted for permissions to use their high definition quality film (Appendix B). The natural film included a segment of a slow flowing river with surrounding area, clips of empty Hawai'i beaches, and a film highlighting trees and forest pathways.

Care was taken to parallel both films into three major segments. Water, a feature known for its pervading psychological influence was put first in both the urban and natural films. The films were displayed on personal computer screens at the full screen

setting and headphones were used for audio. Films were of the same length, with similar transition periods.

Procedure

Participants were randomly assigned to view either a film of urban (Condition A) or natural environments (Condition B). Each session alternated the condition so all participants were exposed to the same environment at one time. Participants arrived at a cognitive psychology testing lab in an accessible campus building. At the time of arrival, the study was briefly introduced and a consent form completed for each individual. Demographic information was gathered at this time. After signing the consent form, participants were verbally and visually given directions on the correct procedure for the Attention Network Test, after which they completed the 20-minute computer formatted procedure. The lights of the windowless lab were dimmed at the time of the film viewing to create a greater extent of immersion during the video testing. After concluding their viewing of the film, participants answered 14 questions from an adapted version of the Perceived Restorativeness Scale (PRS). This was completed in approximately 5 minutes. The participants then completed the ANT for a second time to assess changes due to exposure to one of the two environment films. At the conclusion of the ANT, participants were debriefed, thanked for their participation, and given a small slip for credit hours. Total time spent was approximately 1 hour and 15 minutes.

Data Analysis

A three-way (Condition, Time, Warning type) factorial ANOVA was used to analyze the executive function data from the ANT. Raw response times were recorded for each of the 288 trials on the ANT, these data were collapsed into means, and data were analyzed at the subject level. The PRS composite and subscores were assessed by *T*-test analysis to observe differences between groups for judgments of the perceived restorative properties of environments depicted in each condition.

Inference Making

Tables 2 and 3 outline threats to making valid inferences and how these were or were not controlled.

Table 2.

Threats to Internal Validity

Threat	Controlled	Explanation
History	Generally	Participants were removed from analysis if a significant event occurred between each ANT measurement.
Maturation	Yes	Because of the short time period involved in the study, long-term maturation is not expected.
Testing	Partially	An improvement in response time on the ANT is expected on the postmeasurement. The PRS was used only one time.
Instrumentation	Generally	The same versions of the ANT and the adapted PRS were presented to all participants.
Selection bias	Partially	Each alternating session determined the condition; however, participants were drawn from a limited sample pool.
Attrition	Generally	No attrition was encountered due to the relatively short time of the experiment. However, some participants chose to participate in an alternative assignment rather than the study.
Diffusion of treatment	Generally	Because the subject pool sample has social contact, diffusion may have occurred. However, social interaction during the experiment was minimal.

Table 3.

Threats to External Validity

Threat	Controlled	Explanation
Subject generalization	Partially	Group differences based on assignment were assessed.
Generalizing across settings	No	Study was conducted in only 1 lab setting and capture six different environments.
Time	Partially	Participants took part in the study during a weekday (9am-7pm) and toward the end of a school semester.
Generality across behavior change agents	Generally	Films were coordinated into similar transition times, and similar features relating to either urban or nature.
Reactive experimental arrangements	No	Participants volunteered for the study.
Reactive assessment	No	Performance measurement is overall transparent for the participants.
Pretest sensitization	Generally	Pretest measurement will serve as a baseline for both comparison groups.
Multiple-treatment interference	Generally	Participants will only experience one independent variable exposure

CHAPTER IV

RESULTS

Descriptive Statistics

The Attention Network Task requires 288 trials in three time blocks. Additionally, each participant completed the test two times therefore experiencing 576 trials, each lasting <4000msec. Response times (RTs) during this study were consistent and comparable to ANT response time literature (Fan et al., 2002). Outlying response times (RTs $\leq$ 200, and RTs $\geq$ 800) were omitted from the analysis.

When working with response times, a high percentage of accuracy of arrow direction assessment is expected and necessary to ensure the participant was engaged in the assessment. ANOVA analysis displayed the mean accuracy of responses for the executive measure trials. All conditions had mean accuracy scores of .88 or greater with 1 being perfect accuracy. These small numbers of inaccurate trials were also removed from analysis to minimize response time error.

Analysis of the English Fluency and Task Questionnaire showed that 100% of the participants specified that English was either their native language or they considered themselves fluent in English. Less than 1% of participants indicated they had formerly completed the Attention Network Task. The distribution of response times in these samples was assumed to be normal. Figure 1 displays a histogram and normal curve of

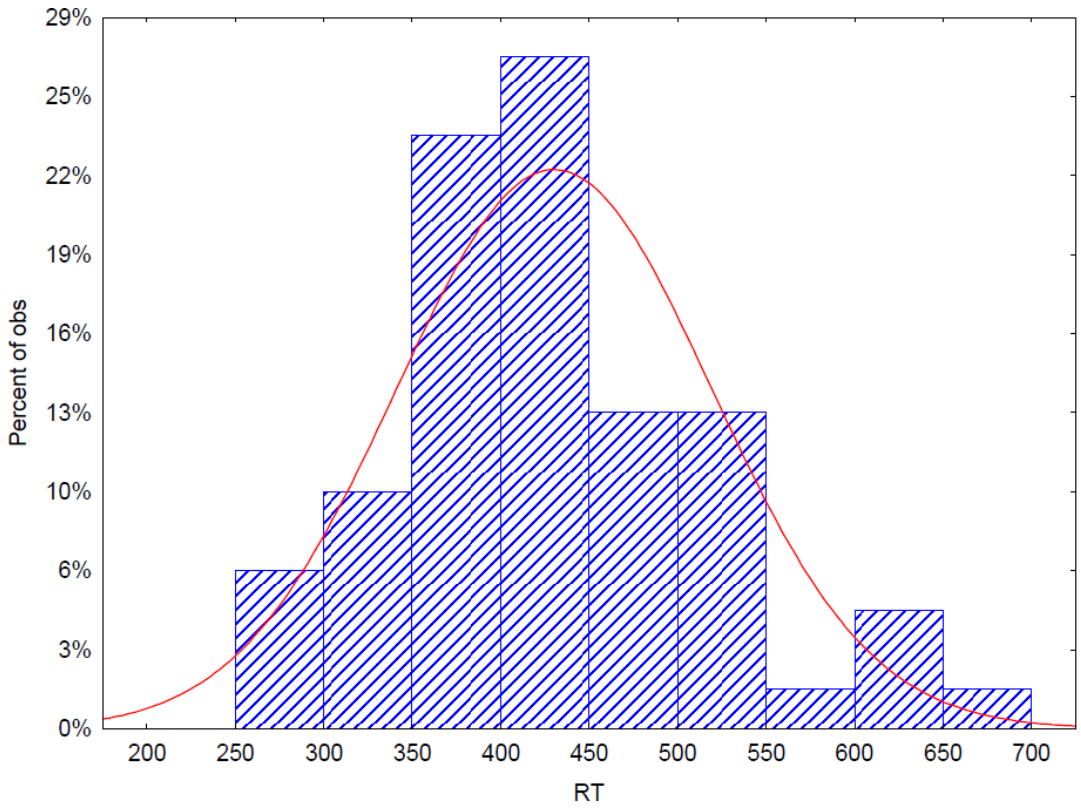

Figure 1. Distribution of Response Time on Attention Network Test

response time data on the Attention Network Task, mean = 428.92 standard deviation = 88.78. Mean response times for the Nature and Urban conditions are presented in Table 4. Mean response times for each condition (Nature versus Urban) during pre- and post-assessments are presented in Table 5. All groups seem to exhibit similar means, with obvious improvement from the pre- to posttest in both conditions. Height (Kurtosis) of the distribution was somewhat high with scores regressing to the 500ms mark (see Figure 1). Most Response times on the observations were around 500ms.

Table 4

Mean Response Time Scores Dependent on Condition

	Mean	Std.
Condition		
Nature	500.7	72.36
Urban	500.02	71.58
Total	500.38	71.85

Table 5

Mean Response Time Scores Dependent on Condition and Time

	Mean	Std.
Condition and Time		
Nature Pre	511.63	75.75
Nature Post	489.77	67.62
Urban Pre	512.89	74.48
Urban Post	487.16	66.73

In accordance with the hypothesis that restorative environments help an individual to think flexibly and thus lower response times on a conflict switch task, correlational analyses were performed to assess the possible correlation of Perceived Restorativeness with response time on the Attention Network Task. In addition, past research has suggested a relationship between amount of education and amount of flexibility an individual exhibits. Thus, level of education and ANT response times were also correlated. Both correlational analyses showed weak (less than .1) and nonsignificant correlations.

Hypothesis Testing

It was hypothesized as a manipulation check that scores on the Perceived Restorativeness Scale (PRS) would be higher for those viewing natural environments than those viewing urban environments due to the restorative effects nature has been shown to have on attention. *T*-tests showed that overall, participants who viewed the film containing scenes of natural environments scored higher on the Perceived Restorativeness Scale (mean = 63, *SD* = 13.97) than those who viewed the film of urban scenes (mean =35.39, *SD* = 18.79, $t(61)= 6.63$, $p<.001$). See Figure 2 for a boxplot graph of these means. Additionally, participants in Condition B (Nature) scored each question and sub-scale including Being Away, Fascination, and Compatibility higher than participants in Condition A (Urban). Table 6 displays the means and significance for each dimension. The exception to this was the subscale for the Dimension of Extent as well as individual questions number 7 and 8 on the PRS. Question seven stated “These places

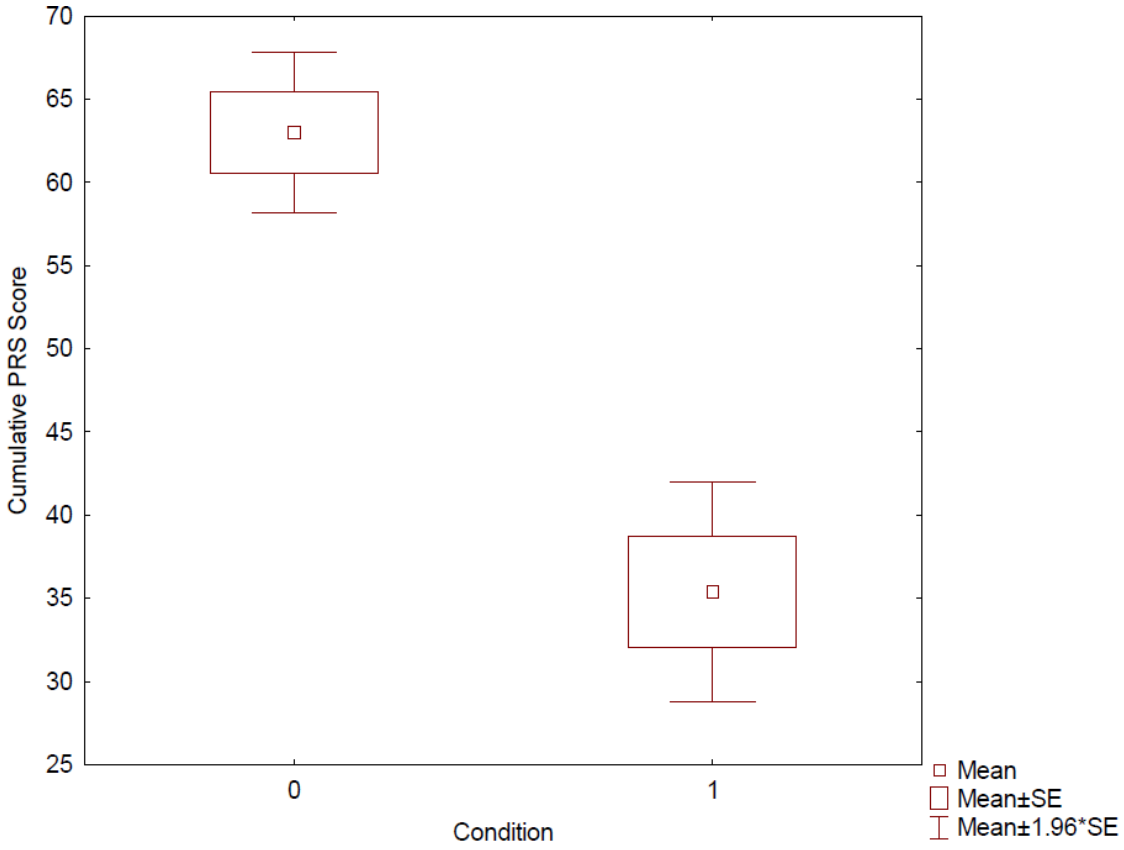

Figure 2. Box Plot of Means on Perceived Restorativeness Scale by Condition

Table 6

Mean Response Perceived Restorative Scale by Dimension (N = 63)

Dimension	Degrees of Freedom	Nature Mean *N*=32	Urban Mean *N*=31	*T* value	*P* value
Fascination	61	13.94	7.55	5.97	<.001
Being Away	61	14.91	6.71	7.51	<.001
Extent	61	11.25	9.94	1.27	.21
Compatibility	61	13.34	7.48	5.38	<.001
Restorative Questions	61	9.56	3.71	7.98	<.001
Total PRS Scores	61	63.0	35.39	6.63	<.001

have landmarks that would help me get around" and question eight stated "It would be easy to find my way around here." See Table 7 for *T*-test results on all PRS questions.

In order to assess the differences between the participants' response time scores on trials with incongruent and congruent Warning Type, dependent on their Condition (natural/urban) as well as time (pre/post), a three-way ANOVA was used.

The three way interaction between Condition, Time, and Type was found to be significant F (1, 61) = 4.33, p<.05. The main effect for Condition was nonsignificant F (1, 61) =.004, p= .95. Main effects for Time and Warning Type were found to be significant with F (1, 61) = 46.5, p<.001, and F (1,61) = 838.5, p<.001, respectively. An interaction effect, displayed by Figures 3 and 4, was also detected between Time and Warning Type F (1, 61) = 9.28, p<.01, but no significance was found for Condition by Warning Type, F (1,61) = .012, p= .91 or Condition by Time, F(1,61)= .31, p=.58. See Table 8 for full display of squares and significance testing.

Tukey Honestly Significant Difference post Hoc analysis was run to find where the groups differed. All means were found to be significantly different from another at the p<.001 aside from the postscores between urban and nature groups, p=.41.

Exploratory Analyses

In addition to the executive functioning arrow switching task, the ANT captures data on the ability to alert attention to a stimuli, as well as orient attention to a specific space. Three-way factorial ANOVAs were conducted to test for differences in response time between groups for both the alerting and orienting measures. Significance tests for

Table 7

Mean PRS Scores Dependent on Condition

Dimension		Condition	
		Nature	Urban
Fascination			
	I would like to spend more time looking at the surroundings here.**	4.41	2.1
	My attention is drawn to interesting things here.**	4.41	3.06
	For me, these places are fascinating.**	4.79	2.39
Being Away			
	These places would help me to get away from it all.**	5.06	2.39
	Being in these places would be an escape experience for me.**	4.94	2.19
	Being in these places would help me to get relief from unwanted demands on my attention.**	4.74	2.03
Extent			
	These places have landmarks that would help me get around.	3.58	3.45
	It would be easy to find my way around here.	3.64	3.35
	I could easily form a mental map of these places.*	3.94	3.13
Compatibility			
	Being here suits my personality.**	4.53	2.97
	I have a sense of oneness with these places**	4.38	2.13
	I have a sense that I belong here.**	4.24	2.39
Restorative Questions			
	Being in these places would make me feel restored.**	4.65	1.81
	These places would help me feel restored.**	4.76	1.9

Note. *$p<.05$, **$p<.001$

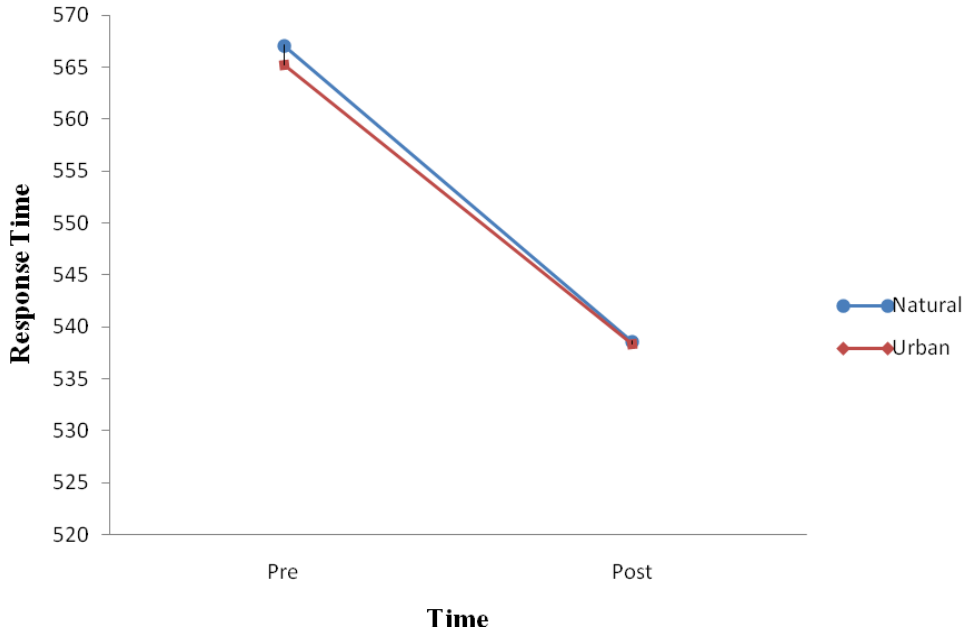

Figure 3. Response Time for Incongruent Trials by Time and Condition

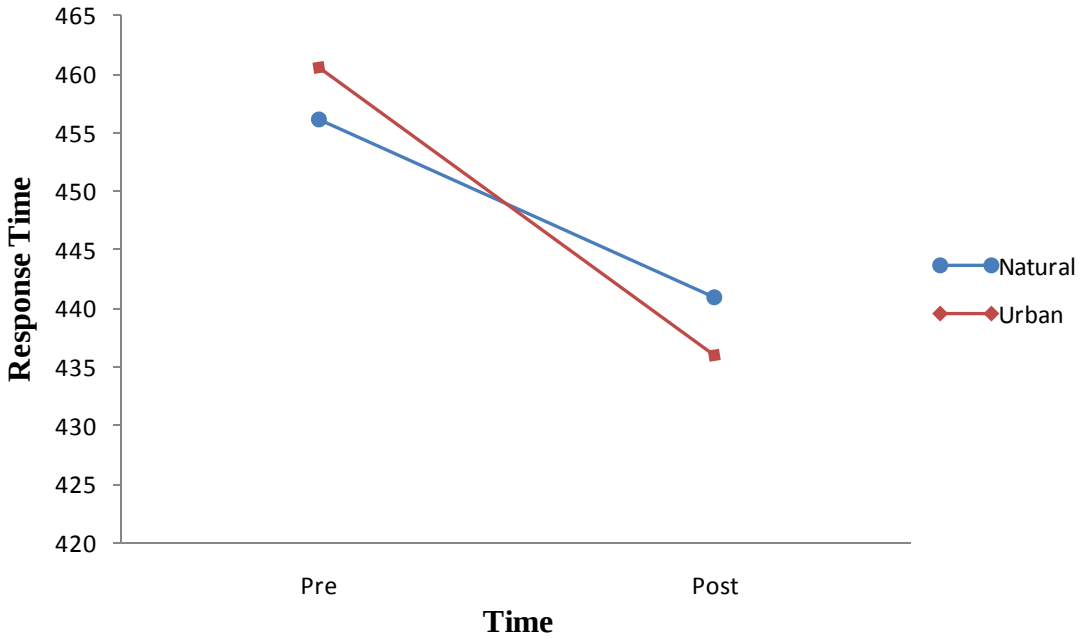

Figure 4. Response Time for Congruent Trials by Time and Condition

Table 8

Significance Test for Executive Attention

	Sum of Squares	Degrees of Freedom	Mean Square	*F*	*P* Value
Intercept	63095513.13	1	63095513.13	8106.806	<.001
Condition	28.74	1	28.74	.004	.952
Time	35402.45	1	35402.45	46.5	<.001**
Type	681166.6	1	681166.6	838.5	<.001**
Condition*Time	235.24	1	235.24	.31	.58
Condition*Type	9.98	1	9.98	.012	.91
Time*Type	1015.64	1	1015.64	9.28	.003*
Condition*Time*Type	474.16	1	474.16	4.33	.04*

Note: *p<.05, **p<.001

main and interaction effects are displayed for the Alerting trials in Table 9. Similar to the tests on executive attention, Time represents pre/posttest, and Condition is nature vs. urban; however, Type indicates whether an alerting cue was given or not at the center of the screen during each trial. Results of this analysis followed patterns of past research in that participants exhibited faster response times for trials where an alerting cue was given than those trials where an alerting cue was not. Table 10 shows significance tests for the Orienting trials, with the Type representing whether the participant was cued to the area in which the directional arrows would arrive or whether they were cued to the center line. Participants displayed quicker response times on trials in which they were oriented than those in which they were not. Additionally, Time was significant with abilities to alert and orient becoming quicker during posttests.

Table 9
Significance Tests for Alerting

	Sum of Squares	Degrees of Freedom	Mean Square	*F*	*P* Value
Intercept	62123419.21	1	62123419.21	9054.40	<.001
Condition	999.4	1	999.4	.146	.7
Time	30477.91	1	30477.91	40.99	<.001
Type	128359.92	1	128359.92	347.19	<.001
Condition*Time	341.19	1	341.19	.46	.5
Condition*Type	40.04	1	40.04	.11	.74
Time*Type	211.55	1	211.55	1.77	.19
Condition*Time*Type	29.41	1	29.41	.25	.62

Table 10

Significance Tests for Orienting

	Sum of Squares	Degrees of Freedom	Mean Square	*F*	*P* Value
Intercept	53673623.48	1	53673623.48	7263.96	<.001
Condition	138.49	1	138.49	.019	.89
Time	30122.67	1	30122.67	36.74	<.001
Type	135376.78	1	135376.78	449.85	<.001
Condition*Time	989.54	1	989.54	1.21	.28
Condition*Type	525.95	1	525.95	1.75	.19
Time*Type	51.8	1	51.8	.34	.56
Condition*Time*Type	13.09	1	13.09	.086	.77

CHAPTER V

DISCUSSION

Previous research has shown differences natural and urban environments have on psychological states. More specifically, differences have been shown in higher order processes of the brain such as executive functioning and attention (Berman et al., 2008). The purpose of this study was to highlight cognitive flexibility as a mechanism of executive functioning and explore if this mechanism is influenced by exposure to differing environments.

Perceived Restorativeness

Hypothesis 1 served as a manipulation check of the condition variable and suggested that individuals viewing a film of natural environments judged those environments to possess more restorative potential than did individuals viewing an urban environment film. Typically, natural environments have been perceived as being more restorative for individuals; however, due to the depiction of the environment being by film, and the film being new to experimentation, it was important that participants in the study felt that the natural environment as depicted did indeed have more restorative potential. The results supported this hypothesis and composite scores on the PRS for the nature group were significantly higher than those of the urban group. Further, results

showed that (with the exception of Extent) all restorative environment dimensions (Fascination, Being Away, and Compatibility) were scored higher by participants assigned to the Nature condition than those of the Urban condition, suggesting that participants would find the beach, forest, and river scenes depicted in the nature film more restorative than viewing man-made fountains, busy streets, cars, and buildings. However, nonsignificant differences in the Extent variable questions suggest participants do not feel more able to find their way around the nature areas or use landmarks as a way to pathfind greater than they are able to in an urban environment (as shown by the lower scoring on two extent variables). The third extent question concerning the ease in which one could make a mental map of the place acted similarly to that of the other dimension questions and was scored higher by those in the Nature group. While previous factor analysis has shown a grouping of these three extent variables previously, the reliability of the extent questions during this study was lower than for the other dimensions (see Table 1). Additionally, perhaps the internal nature of the third extent question is thematically different from the other extent questions. Participants may feel like they could envision the natural places more easily by making a mental map but at least in this sample do not necessarily believe they could pathfind more readily than in an urban setting. Reliability analysis of the PRS indicated questions aside from those assessing extent are highly correlated and have a high interitem reliability supporting the use of the PRS in the future if used for inference making.

Cognitive Flexibility

The response times on the ANT in this study were comparable to that of other studies, thus providing some reliability for the accuracy of the dependent variable measure. Additionally, overall accuracy on the ANT arrow direction assessment was above 95%, indicating that participants were reliable in giving responses. The results of this study do not support previous findings that natural environments *restore* executive attention networks such as the ability to be cognitively flexible by assessing conflict when processing arrow direction. However, an interaction effect was found such that individuals who were exposed to an urban setting sped up significantly on the posttest. Specifically, scores were faster on congruent trials of the arrow direction measure. The interaction between Condition, Time, and Warning type was found only in the executive attention measure and not in orientation or alerting attention networks. In both groups it seems that participants exhibited the most movement toward faster response time in congruent trials. This may indicate that the most recognition and learning in short pre/postinterval tasks occur in identifying congruent stimuli. Surprisingly, environment also seems to play a role in this with individuals exposed to the urban environment exhibiting significantly faster response times on congruent trials. While the results fail to suggest that the ability to mentally switch due to conflicting stimuli is influenced by environment, it seems that exposure to an urban environment may perpetuate habitual thought processes that come to us more readily. These results draw reason to consider that rather than overall attention restoration and increased performance on executive attention measurements occurring due to natural environment exposure, exposure to urban environments may bring about increased processing of familiar and automatic, but

not novel, responses. This conclusion is tentative at best as this study did not use a neutral condition and while it is apparent that mean scores on congruent trials differed by condition, we cannot determine whether the nature film provided some form of resistance to automaticity or the urban film assisted in processing of these congruent stimuli.

This study leaned heavily on methods practices of the second experiment by Berman et al. (2008). However, this study had more than double the sample size but did not use repeated measures. Additionally, this study relied on film rather than still photographs and did not focus on attention depletion prior to environment exposure. Results of these two experiments have both similarities and marked differences. One similarity is the differences in results of the attention networks. The utility of the Attention Network Task provides "a means of fractionating the functional contributions of areas within the executive attention network" (Fan et al., 2002, p. 341). Similar to the Berman article, the significant interaction effect between Condition, Time, and Type indicate that environment influences conflict assessment (executive function) whereas alerting and orienting attention networks continue to be unaffected. During analysis, Berman et al. relied on difference scores on the ANT rather than raw response time data (as in the present study). Fan et al. (2002) noted the decreased reliability of using the subtraction method while they found correlation with all three attention networks by using this method. Sample sizes were drastically greater in the Fan et al. article than those of the Berman et al. study.

Limitations

One of the most important limitations of the present study is the issue of dosage, that is, the amount and kind of exposure to an environment in order to obtain expected psychological affects. While research using exposure to environment by film has shown significant differences in survey type data, specifically emotion measurement, limited research has shown films' effect on executive attention processes. However, research has effectively used still photographs, window views, or walks in actual environments to explain differences (Berman et al., 2008; Berto, 2005; Hartig et al., 2003; Kaplan, 2001; Tennessen & Cimprich, 1995). Still, the amount of time and space elements needed for exposure to environment to illicit predictable differences is unexplained. This specific study is limited because of its sample size, as well as the time constraints on the study. The study was conducted right before and during finals week when demands on executive functions are variable depending on course load, emotional regulation concerning performance in school may vary, and motivation to honestly participate may have been decreased. This was noted as 1 student fell asleep during the study, others mentioned they were pressed for time, and others attempted to "sneakily" check phone messages, etc. While some of this variability was controlled for, it can be expected that a stronger dosage of exposure to real-world environment would demand participants to cue into what was around them differently than a computer screen in a lab-like setting. This type of research presents its own set of challenges though, as control of extraneous variables is difficult.

Future Directions

The findings of this study continue to support the need for researchers' continual efforts to explain how nature versus urban environments impact higher cognitive processes. Future research might attempt to explain the amount of time needed in a particular environment to facilitate the predicted result. Additionally, quantitative and qualitative research is necessary in a variety of fields. Biological differences as well as self-reported detailed accounts of psychological factors may all play a role in explaining how qualities such as cognitive flexibility that have both a micro and macro manifestation are influenced by environment. Still, several writers, researchers, and individuals have noted the qualitative difference of thoughts expressed by those who have spent time in natural environments versus an urban or everyday environment (Farber & Hall, 2007; Kaplan, 1982). Research needs to continue to specify which types of and areas of cognition and brain activity are impacted by environment. The results of this research support past research in suggesting that environment in general has a greater impact on conflict assessment and executive functions than on other attention networks. Future research specific to environment and cognitive flexibility might explore macro and micro scale studies. Researchers may gain more information by measuring the ability to state alternating points of view as well as measuring the brain activity in areas associated with cognitive flexibility such as the prefrontal cortex, the left lateral regions, and the basal ganglia using techniques such as Functional Magnetic Resonance Imaging.

Conclusion

Cognition has a tremendous impact on quality of life. Cognitive rigidity and flexibility vary due to several factors such as education, mental and physical illness, or injury and genetics. Health professionals of all types attempt to treat both the cause and the symptoms of unhealthy cognitive processes like rumination and perseveration. This study focused on college students both because of their suspected variability in cognitive flexibility as well as being a convenience sample. Further research may target specific populations known for ruminative tendencies. If working with individuals without diagnoses, it may be effective to facilitate an intellectual perseveration and then assign individuals to an environmental condition. If practitioners are curious about how to help populations with diagnoses become more cognitively flexible, more research is needed with individuals that struggle with addiction, obsessive compulsive behaviors, eating disorders, anxiety, and depression, as well as how children on the Autistic spectrum react with a variety of environments.

Chang and Chang (2010) recently presented a qualitative study on the benefits of outdoor activities for children with Autism. Caretakers, teachers, and parents of children with Autism noted the most common benefits of activities outdoors are increased initiation due to changing stimuli that bring up new conversation, increased quality and content of speech, decreased ritualistic behavior, and increased ability to accept changing circumstances. These benefits are achievable through flexible cognitive processes adapting as needed by a changing environment. As evidence for positive health outcomes due to environment exposure continue to be revealed, efforts to promote and facilitate these interactions are necessary. While research continues to expand and attention grows,

the power and importance of environment is often ignored by health care practitioners. Because Recreational Therapists' background requires a base knowledge of both disability and leisure options, the field is uniquely positioned to facilitate experiences in a variety of settings depending on the needs of the individual and the evidence given to accommodate for those needs.

APPENDIX A

QUESTIONNAIRES

Perceived Restorativeness Scale

Please rate your agreement/disagreement with the following statements in regards to the environments in the film you just watched.

1. I would like to spend more time looking at the surroundings here.

Not at all 0 1 2 3 4 5 6 Very Much So

2. My attention is drawn to interesting things here.

Not at all 0 1 2 3 4 5 6 Very Much So

3. For me, these places are fascinating.

Not at all 0 1 2 3 4 5 6 Very Much So

4. These places would help me to get away from it all.

Not at all 0 1 2 3 4 5 6 Very Much So

5. Being in these places would be an escape experience for me.

Not at all 0 1 2 3 4 5 6 Very Much So

6. Being in these places would help me to get relief from unwanted demands on my attention.

Not at all 0 1 2 3 4 5 6 Very Much So

7. These places have landmarks that would help me get around.

Not at all 0 1 2 3 4 5 6 Very Much So

8. It would be easy to find my way around here.

Not at all 0 1 2 3 4 5 6 Very Much So

9. I could easily form a mental map of these places.

Not at all 0 1 2 3 4 5 6 Very Much So

10. Being here suits my personality.

Not at all 0 1 2 3 4 5 6 Very Much So

11. I have a sense of oneness with these places.

Not at all 0 1 2 3 4 5 6 Very Much So

12. I have a sense that I belong here.

Not at all 0 1 2 3 4 5 6 Very Much So

13. Being in these places would make me feel restored.

Not at all 0 1 2 3 4 5 6 Very Much So

14. These places would help me feel restored.

Not at all 0 1 2 3 4 5 6 Very Much So

Demographic Information

1. Please Check one:

__Male __Female __Transgender

2. What is your age? ____

3. What is the highest level of education you have completed? (please check one)

__High School Diploma __GED

__College Freshman __College Sophomore

__College Junior __Undergraduate Degree

__ Masters __Phd or Phd Candidate

4. What is your current marital status?

__Married __Single __Civil Union

Debriefing Form

In the present study, we were interested in understanding the effect that certain types of images (either all nature images or all urban images) had on a person's capacity to carry out a cognitively challenging task. Previous research suggests that a person can obtain a number of cognitive benefits from spending time in a natural setting (Hartig, Mang, & Evans, 1991; Kaplan & Talbot, 1983; Ulrich, 1981). Some of the most compelling work in this area has been to identify and confirm the effects that natural settings have on a person's capacity to direct attention (Taylor, Kuo, & Sullivan, 2001; Wells, 2000). Natural settings presumably elicit a form of attention that is less demanding, which in turn can allow mechanisms of directed attention (including cognitive flexibility) to replenish. Unlike natural settings, urban settings tend to capture a person's attention more dramatically, requiring a person to block out distractions in order to stay focused.

Drawing on that research, this study intends to examine how a person's performance on the arrow direction attention task varies as a function of the types of images that person viewed during the film portion of a lab session.

For so many people, nature provides a much-needed break from the demands of everyday life. Developing a better understanding of the reciprocal benefits that nature may offer a person can have a variety of practical implications. Can you think of ways in which this information may be used?

For additional information on both the manipulations used and the hypotheses tested in the present study, we would like to refer you to the following research article: Berman, M. G., Jonides, J., & Kaplan, S. (2008). The Cognitive Benefits of Interacting with Nature. *Psychological Science*,*19*(12), 1207-1212.

If you have any additional questions about this study, please do not hesitate to contact the PI by phone at 801-400-8408 or via email at anniken.rose@gmail.com. You may also contact the Co-investigator by phone at 801-585-7956 or via email at jason.watson@psych.utah.edu. The PI and his research team thank you for your participation. Please take this debriefing form with you upon completion of the study.

Thanks again, and have a great day!

Questionnaire CF

Participant ID # _____

Instructions: Please take 5-10 minutes to provide answers to the following four questions.

(1) Before today's experiment, did you have any knowledge of the effects that nature could have on attention. If so, please briefly describe where you previously learned about this topic (e.g., class lectures, other experiments in which you participated, other sources)?

(2) Before today's experiment, did you have any knowledge of the arrow direction attention task that was administered during the present study? If so, please briefly describe where you previously learned about this task (e.g., class lectures, other experiments in which you participated, other sources)?

(3) Would you consider yourself to be a native English speaker (i.e., English is your 1st language)? If not, would you consider yourself to be a fluent speaker of English?

APPENDIX B

FILM AUTHORS

Title	Author
Insights into a Lively Downtown (Urban Planning, Ann Arbor, Michigan) High Quality Resolution Version	Kirk Westphal
Forest Meditation HD	Kedar from KedarVideo
HD Hawaii Beaches	WavesDVD.com
Relaxing Water Films: Riverflow Part 1/2	http://www.gccreativestudio.com/videos/WaterFilms/
Seattle Fountain HD	N. Ravis
Walking through the Bellagio to the Fountains “Time to Say Goodbye”HD	David Sauer
Editing and Revision	Brandon L. Hatch

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